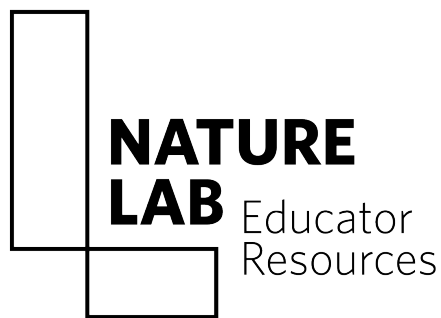




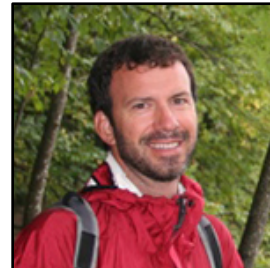
VIRTUAL FIELD TRIP TEACHER'S GUIDE

Powering the Planet: Renewable Energy

Grades: 3-8

Subjects: Science

Purpose: This guide contains information on teacher preparation for the event, technical information, as well as a variety of student materials, which can be used before, after, or during the virtual field trip. It also contains links to other resources ranging from lessons, activities, demonstrations, experiments, real-time data, and multimedia presentations.



Alex Wegmann
Palmyra Program Director
The Nature Conservancy

Description of Virtual Field Trip: We use energy to power our lives every day—to boot up our computers, fuel our cars, charge our cell phones, flick on a light switch, and in a myriad of other ways. Join scientist Alex Wegmann as we embark on a Virtual Field Trip to explore a compelling question: How can we get the energy we need without harming nature? By harnessing renewable sources of energy, such as sunlight and wind, scientists are finding ways to do just that.

On this journey, we'll visit the Palmyra Atoll, a wildly remote cluster of islands atop coral reefs and teeming with animal life. Scientists there have developed ways to power the entire island almost exclusively through renewable energy sources. We'll also journey to the scorching Mojave Desert, home to rattlesnakes, tortoises, bats, and coyotes, to check out massive solar panel installations that are working to power large cities. We'll learn about innovative methods for capturing energy that are safe, sustainable, and can change the destiny of life on our planet.

Materials:

Elementary School

- **Nature Spy Handout**
This handout includes images of animals and other items that students will see during the field trip. Print it off and have students check off the images as they see them.
- **Renewable Energy Virtual Field Trip Log**
This one page handout can be printed and used before, during, and after the field trip for students to think about what they hope to see, what they learned, what they want to know more about.
- **Renewable Energy Vocabulary Graphic Organizer**
This handout includes vocabulary words used during the virtual field trip and provides a structure for students to define and use them in a sentence.

VISIT...

LANZAROTE
Caliente.COM

Middle School

- **Renewable Energy Virtual Field Trip Discussion Questions**

This fourteen question handout can be used during and after the virtual field trip. You can modify the questions as needed or use them as discussion prompts after the trip. The answer key is located at the end of this teacher's guide.

Standards: A more detailed, grade-based map to the standards can be found here:

Next Generation Science Standards Disciplinary Core Ideas

- ESS3.A Natural Resources
- ESS3.C Human Impacts on Earth Systems
- ESS3.D Global Climate Change
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS4.D Biodiversity and Humans

Related Nature Works Everywhere Resources: The following lesson plan and video can be used to supplement the virtual field trip.



Renewable Energy

Grade Levels: 6-8

In this lesson, students explore solar and wind power—two important renewable energy sources. Unlike the nonrenewable energy sources that humans currently use (fossil fuels, coal and natural gas), solar and wind power can quickly replenish themselves and are usually available in a never-ending supply. Acting as residents of different regions, students weigh the pros and cons of each renewable energy option for a region, and make a recommendation based on their evaluation.

Discussion Questions: You can use or adapt these questions for a follow-up discussion with your students after viewing the virtual field trip. Older students may be able to follow along and answer the questions while viewing.

1. List at least two ways we get energy to power our lives.

Answer: Burning coal, gas, burning wood, biodiesel, algae/biofuel, wind, sun, water, geothermal, etc.

2. In the virtual field trip, Dr. Alex Wegmann talked about the importance of the bird guano to the ecosystem. Describe the role that guano plays on Palmyra Atoll.

Answer: The birds eat fish and other organisms from the marine environment and when they defecate, the nutrients from the marine environment are essentially transferred to the terrestrial environment. The guano (feces) acts as a fertilizer for the plants. The plants in turn support life on the islands (geckos, insects, etc.). The island's heavy rainfall pushes nutrients from decomposing plants or dead organisms back out to the ocean where they came from originally. Everything is connected.

3. Why is Palmyra a perfect place to study how a marine ecosystem responds to climate change?

Answer: Palmyra is a perfect place to study how a marine ecosystem responds to climate change because it has little human influence from things like pollution or overfishing. It is as close to a pristine environment that you can get and therefore, the changes observed are less likely to be caused by other variables related to human influence.

4. What is the difference between renewable and nonrenewable resources? Provide examples of each.

Answer: Renewable resources include the sun and wind and are things that can be "replenished" or are not used up. Nonrenewable resources include fossil fuels like coal and oil that took a long time to form and are not as easily replenished. For example, coal and oil are more likely to be used up before more can form because the process takes so long.

5. What is the reason for the special design of Palmyra's wind turbine (shown below)?



Credit: Cindy Coker

Answer: The wind turbine has a much different design than regular turbines because of the importance of the atoll as a nesting ground for thousands of birds. Regular wind turbines can harm birds and it was important to prevent this happening on the islands to limit human impact while harnessing wind power.

6. Why was it necessary to install solar panels and a wind turbine on the atoll?

Answer: The wind turbine is intended for use as a back-up energy source in the event of bad weather, heavy cloud cover, or nightfall that could limit solar power production. Using renewable energy on Palmyra also helps keep costs down while protecting the environment.

7. What is the relationship between fossil fuels and carbon dioxide?

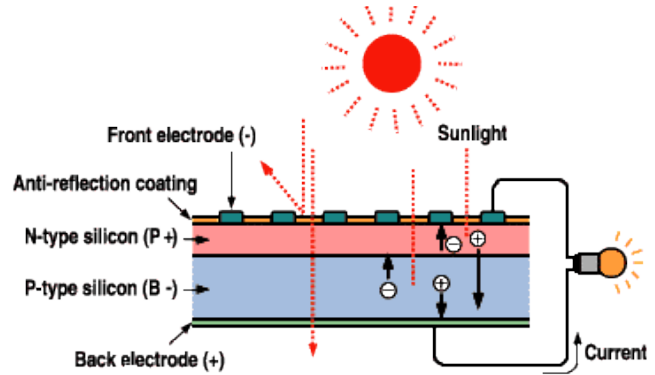
Answer: When fossil fuels are burned or combusted they release carbon dioxide into the atmosphere.

8. What is an important chemical component of solar cell (also known as a photovoltaic cell)?

Answer: Silicon

9. Describe what happens when a photon (a packet of light energy from the sun) hits a solar cell.

Answer: When photons hit a semiconductor on a solar panel, their energy frees some electrons in the semiconductor material. The electrons create an electric current, which is harnessed by wires connected to the positive and negative sides of the cell. The amount of electricity that can be produced depends on the number of cells in each solar panel and the number of panels in a whole facility.



Credit: Bureau of Labor Statistics

10. How does concentrating solar power (CSP) differ from photovoltaic cells?

Answer: Concentrating solar power involves a series of mirrors that reflect sunlight onto a solar power tower. Water contained in the tower gets heated up by the reflected sunlight. When the water is heated, it produces steam, which turns a turbine and generates electricity.

11. How do fossil fuels contribute to climate change?

Answer: When fossil fuels are burned, they release greenhouse gases like carbon dioxide into the atmosphere. Greenhouse gases contribute to climate change because they create a layer of gas in the atmosphere that can trap heat. Normally some of the sun's energy gets reflected back out into space, but when there is a layer of greenhouse gases, heat can be trapped, causing warming.

12. How do engineers and scientists decide where to locate solar facilities?

Answer: The first consideration when locating a solar facility is the amount of solar radiation a site receives. This makes the desert Southwest a prime location for siting solar facilities. Other considerations include how much the land will be disturbed. For example, solar facilities can destroy animal habitat, so it's important to choose locations that will have less impact on animals and plants and/or choose sites that have already been disturbed like abandoned fields. Additionally it's important to note where major migration routes exist so as not to block the movement of animals.

13. In the United States (in 2015) how much electric power was generated from renewable resources?

Answer: Only 13%

14. What are some ways the students and other people can help to make a difference when it comes to energy use?

Answer: You can turn off lights when you leave a room. While reducing energy use is a good start, it's not always practical. Switching out old incandescent light bulbs for newer, more energy efficient bulbs like LED bulbs or compact fluorescent bulbs can save a lot of energy when the lights are on.

Virtual Field Trip Standards

Powering the Planet: Renewable Energy

[Next Generation Science Standards](#)

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

Grade	Topic	Disciplinary Core Idea	Performance Expectation
K	Earth Systems	ESS3.A Natural Resources - Living things need water, air, and resources from the land and they live in places that have the things they need. Humans use natural resources for everything they do.	K-ESS3-1 Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
K	Earth Systems	ESS3.C Human Impacts on Earth Systems - things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
2nd grade	Life Science	LS4.D Biodiversity and Humans - There are many different kinds of living things in any area, and they exist in different places on land and in water.	2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.
3rd grade	Life Science	LS4.D Biodiversity and Humans - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

3rd grade	Life Science	LS2.C Ecosystem Dynamics, Functioning, and Resilience - when the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.	3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
Grade	Topic	Disciplinary Core Idea	Performance Expectation
4 th grade	Physical Science	ESS3.A Natural Resources – Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
5th grade	Earth Systems	ESS3.C Human Impacts on Earth Systems - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Middle School	Life Science	LS2.C Ecosystem Dynamics, Functioning, and Resilience - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.	MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
Middle School	Life Science	LS2.C Ecosystem Dynamics, Functioning, and Resilience - Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Middle School	Life Science	LS4.D Biodiversity and Humans - Changes in biodiversity can influence humans' resources such as food, energy, and medicines, as well as ecosystem services that humans rely on - for example, water purification and recycling.	MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
---------------	--------------	---	---

Powering the Planet Virtual Field Trip Log

BEFORE

I know that..._____

I wonder if..._____

I hope that..._____

AFTER

I want to know more about..._____

My favorite part was ..._____

I learned that..._____

Imagine you are in the Mojave Desert or Palmyra Atoll – what would you be doing? On the left, draw a “selfie” of yourself on your trip.

Rate this virtual field trip by coloring in the number of stars you would give it!

What does it mean?

Word: **Atoll**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Word: **Terrestrial**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Word: **Invertebrate**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Word: **Renewable**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Word: **Non-renewable**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Word: **Fossil fuels**

Definition:

Part of speech:

- Noun
- Verb
- Adjective
- Adverb

Sentence:

Powering the Planet: Renewable Energy

Discussion Questions

1. List at least two ways we get the energy to power our lives.
2. In the virtual field trip, Dr. Alex Wegmann talked about the importance of the bird guano to the ecosystem. Describe the role that guano plays on Palmyra Atoll.
3. Why is Palmyra a perfect place to study how a marine ecosystem responds to climate change?
4. What is the difference between renewable and nonrenewable resources? Provide examples of each.
5. What is the reason for the special design of Palmyra's wind turbine (shown below)?



Credit: Cindy Coker

6. Why was it necessary to install both solar panels and a wind turbine on the atoll?
7. What is the relationship between fossil fuels and carbon dioxide?

8. What is an important chemical component of solar cell (also known as a photovoltaic cell)?
9. Describe what happens when a photon (a packet of light energy from the sun) hits a solar cell.
10. How does concentrating solar power (CSP) differ from photovoltaic cells?
11. How do fossil fuels contribute to climate change?
12. How do engineers and scientists decide where to locate solar facilities?
13. In the United States (in 2015) how much electric power was generated from renewable resources?
14. What are some ways the students and other people can help to make a difference when it comes to energy use?